



International Journal of Advanced Academic Studies

E-ISSN: 2706-8927

P-ISSN: 2706-8919

www.allstudyjournal.com

IJAAS 2020; 2(4): 499-503

Received: 12-11-2020

Accepted: 17-12-2020

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The importance of using stories for teaching-learning of mathematical concepts

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DOI: <https://doi.org/10.33545/27068919.2020.v2.i4h.445>

Abstract

Mathematics, being a discipline of facts and skills, is often memorized which creates mathematical phobia in students. (Teaching of mathematics, maths position paper, NCERT, 2006) "In maths classroom, where problems that require mental maths or processes are involved students lose interest and face many problems. It may be because of reading, comprehension, and difficulty in understanding which process is involved in the question." (Zorfass J, n.d., 2014).

During the teaching internship in one of the government schools of Hauz Khas in Delhi, It was observed that the learning level of primary grade students in mathematics was high. They performed problems that involve computation easily and with great interest. However, when it comes to word problems or the NCERT textbooks problems which involve stories, students lose interest and feel anxious. They face problems while reading and comprehending. They are not able to reach the level where they use processes. They have fear of solving word problems.

However, Stories create interest in a child's mind which engages them, creates excitement, and can motivate them to think about a particular problem as Judson G., (2017) say "Stories convey enthusiasm and evoke imagination skills."

Moreover, "Stories can engage children to critically think about the process that is involved and think about how things are going as it is related to daily life." When children listen to a story, it creates mental images in their minds and connects to the content making learning more meaningful. Stories provide children, experience which enables children to think as if it has happened with them which leads to the creation of problem-solving ability in children and a sense of confidence in children." (Miller S and Pennycuff L, 2008).

Therefore, keeping this in mind, the present study was carried out by using storybooks and tried to analyze how storybooks can affect learning and understanding of mathematics in primary grade students through the qualitative, interpretive, and constructivist approaches.

The major findings of the study are that students were able to use various mathematical skills such as problem-solving, visualization, analogy, communication, logical mathematics, etc to solve mathematical problems incorporated in the story. Moreover, students were able to use conjectures, and the fixation of methods was also removed.

Through this study, it is concluded that using stories to teach mathematical concepts leads to the development of different mathematical skills such as problem-solving, analogical skills, visualization skills, etc. It also helps students to look into the mathematical problems from a different lens and use conjectures to solve them. Henceforth, stories help in developing a child's interest not only in language but also in mathematics.

Keywords: Storytelling, teaching-learning of mathematics, conceptual understanding, teacher-students participation

Introductions

"As we know that mathematics is an abstract subject which often creates fear in a child's mind towards maths." (Goral. M and Gnadinger. C, 2006) ^[1, 5]. "But if concepts are not understood properly then it would leave a long-lasting effect on learning and understanding of mathematics." (Goral. M, 2006, p1) ^[1, 5], "Many researchers suggested that one way of indulging students in the understanding of mathematics could be by using storybooks in a maths classroom." (Chandra B, 2000) ^[25].

"Using Storybook as a medium to mathematical instruction is one of the most enjoyable and effective ways to teach mathematics." (Goral. M. and Gnadinger. C, 2006) ^[1, 5], Many reasons accompany the given statement:

"One reason is that the story appeals to a child's imagination and emotions and makes learning more meaningful. When children listen to stories, they form mental images which lead them to connect with the character." (Goral. M. and Gnadinger. C, 2006, p1) ^[1, 5].

It can be said that stories are the vehicle that moves the metaphor and image into the experience. (Kurtz and Ketchem, 1994, p17) ^[10].

However, storytelling is confused with reading a story. But there is a difference between these two. Storytelling is more personal as compared to reading a story as students connect to the story, use constant eye contact, and make adjustments when necessary to enhance understanding of the story. On the other hand, when the reader reads the text, the Reader focuses on the text and written word and can only make eye contact with the listener periodically. (Isbell R.T, 2002) ^[17]. NCTM (2000, p60) ^[25] also states "communication, talking, listening, writing about mathematics are an essential component in learning mathematics". Therefore, children's literature books should have authentic content that includes life experiences, personal or cultural episodes, and enjoyable plots. When students are given guided instructions through a subject they are more comfortable with, more likely to comprehend concepts, talk to them. Thus, marked improvement can be made in the subjects. (Worley, 2002) ^[17].

However, the story should be such that it follows some Framework that ensures the authenticity of the story. For example, a story in mathematics should be according to their level of the classes. Also, the concept it serves is an important aspect of storytelling, and also, the way of narrating it plays an important role by which students can imagine the character and form mental images and consider the character of the story as someone significant. (Singh PK., 2019) ^[15].

Thus, based on these points, one can use stories in the mathematics classroom.

Objectives of the study

The objectives for this project are

1. To explore the development of various mathematical skills such as problem-solving, logical mathematics, analogical skill, communication, and visualization using storytelling.
2. To analyze the effects of stories on teaching-learning of mathematical concepts.

Research questions

The following questions guided the study:

1. Why is it important to use stories in a mathematics classroom?
2. What type of stories can be used to teach the particular concept?
3. What effects of using the stories would be seen in the mathematics classroom?

Research design

To carry out the study, the qualitative, interpretive, and constructivist approach was used. A qualitative approach was used to carry out the procedure and analyze the data to gain in depth knowledge to understand how different factors together influence the teaching-learning of mathematical concepts.

Tools for the study

Observation tool

The researcher used the observation tool while narrating the story and when students solved the problems and questions

were asked accordingly and also facilitation was given to them.

Three stories related to different mathematical concepts were used as tools for collecting the data of the study.

Story 1 - Fraction story (concept-fraction)

Story 2- Amanda bean's amazing dream (concept-multiplication)

Story 3- Papa ki padhai (concept-division)

The first story was "Fraction story" which included concepts and vocabulary related to fractions. It is a 4:14 min story and was retrieved from the channel of jowist-joy with study.

The second story was related to the concept of multiplication which included the alternative methods of multiplications such as repeated addition, grouping, arrays, and so on. The story's name was "Amanda bean's amazing dream" by Cindy Neuschwander published by scholastic press, New York.

The third story was "Papa ki padhai" which consisted of the concept of division and sub-concepts such as repeated subtraction, division facts, sharing. This story was adapted by papa ko padhana, Amrutash Misra & Swagata Sen Pillai published by Pratham books.

Stories were chosen based on the Framework that ensures the presence of mathematical concepts. (Singh PK., 2019) ^[15].

This Framework consists of the following points:

1. Main mathematical concepts symbolized by the storybook.
2. Relevant level of class in which the story can be used
3. Checking whether the story includes a mathematical concept that fits the syllabus
4. Usefulness of the mathematical concept
5. Integration of the mathematical concept within the units or topics
6. Checking whether the story provides an opportunity to solve the problems related to the mathematical concept presented by the story
7. Introduce The Reader to the language of mathematics.
8. Creating curiosity towards a story in the reader's mind
9. Providing opportunities for an explanation of the story or the problem presented in the story.

Methodology

The purpose of the study was to explore and analyze the development of various mathematical concepts and skills such as problem-solving, logical mathematics, etc. using story-telling. The study was done during the period of researcher school internship at one of the SDMC Schools of Hauz Khas village. The students of class 4th were the sample for this project. Constructivism was adopted as a research paradigm.

Research Design was a qualitative, technical action research approach.

The research tool chosen for the study was stories based on a Framework which was used throughout the week with a particular sub concept that was done in a day. For example, repeated addition has been taken for day 1, multiplication array for day 2, and so on.

The data was collected by observing the process of how children comprehend the story and the process of solving the problem mentioned in the story with the help of their prior knowledge. Not only observing, but active participation was done with the students to facilitate them.

Questions were asked side by side to get an insight into the child's thought process.

The primary data for the study consists of semi-structured interviews that were done while students were participating in the process.

The one-story, chosen for the research, was in Hindi. However, story 2 was in English but it was narrated in Hindi as it was students' first language and helped them to connect with the character more easily.

Observations, as well as questions, were asked during the intervention process when children were trying to solve the questions posed in the story helps to know the insight of the child's thought process as they form mental images of the character of the story as someone significant and also provide insight into the child's conceptual understanding.

Analysis

By analyzing and referring to the collected data, it is concluded that by using the stories in teaching-learning of mathematics, the teacher could observe the development of various skills such as analogical, logical reasoning, conjecture, communication skills which is difficult to find in a traditional classroom where student focus only on the computation of the problem that is involved in it. They focus more on rote memorization of concepts rather than understanding the concept.

It has also been analyzed that by using stories, children can process the information that is given in the story and try to apply it in the same way that they apply in daily life which is not possible when using traditional methods in teaching mathematics. This is because while using stories, children connect to the character of the story and consider them as part of their own and get connected emotionally and use a variety of methods to solve their problem. Also, they don't use a particular method to solve the problem, so, in short, they use a heuristic to reach their goal of solving the problem which results in the increased level of students' participation as the story continues day by day. This leads to team/group work among students as their interaction increases which is not the case when children are taught in traditional classrooms.

Thus, this shows that stories have a positive impact on children who study in maths classrooms. Therefore, by using stories in mathematical classrooms, we can see that children can display a variety of skills and understand the concept better.

Findings and Results

The stories taken for the present research were of different concepts such as fraction (Fraction story), division (Papa ki padhai), and multiplication (Amanda bean's amazing dream)

1. Stories encouraged problem-solving skills more among students to solve the problem. This finding is confirmed by the study of Amesis, J. in 2002 which reported in his research that "storytelling can be a vital part of the classroom culture of problem-solving.....as they listen to an interactive reading of the story, they can think about and respond to counting based situation in it." (p260).
2. The story helped children to form mental images and use visualization skills more which in turn helped them to explore solutions to the problem. This finding is confirmed by the study of Goral. B. M., and Gnadinger. M. C. (2006) ^[1, 5], found in their study that "storytelling

appeals to a child's imagination and emotions and helps to make learning more meaningful. When children listen to stories, they create mental images that belong to them and connecting the content to something personally significant."(p4)

3. Communication between teacher and the students is also increased as compared when maths is taught in traditional classrooms. This finding is confirmed by the study of Lewis. B., Long. R., and Mackay. M. in 1993 found in their research "when allowed to work together to solve problems, students learn to communicate their mathematical ideas to others, consider alternate viewpoints and try a variety of strategies to solve the problem."(p471)
4. The application of analogy skills got increased through stories which helped children to solve problems. The analogy skill helped children to apply the method in a situation which they had encountered in other situations. This finding is confirmed by the study of Lewis B. in the year 1993 where she says "using analogical stories is one way of helping your students develop and prime these mental pathways to good habits.....analogical reasoning is also used to teach mathematics and problem solving"
5. The application of logic got increased through stories where children used their own logic more to solve the given problem. This finding was confirmed by the study of Gadanidis and Hoogland in the year 2002 where they mention, "When we read or listen to a story, we expect that story to cohere and comply with its own internal logic. When an idea is placed within a story, the events of that story must, as a whole, necessarily support that idea".
6. Stories helped in the removal of the fixation of methods. One skill that was observed in all the 3 stories was the application of different processes to reach the solution. This finding was confirmed by Albool R. M. in the year 2012 where he stated, "The stories provided communication between the teachers and their students, and among the students themselves. So listening to the story and having a dialogue with the teacher and peers about the story events, and then participating in the activity to resolve the problem in the story, each in his/her own way may enhance this standard."
7. Children were able to express their ideas more as they were flexible to use their own methods because of more opportunities available to explore alternative new ideas. This finding is confirmed by Taplin M. where she mentions that "Sometimes pupils can be asked to make up their own problems, which can help to enhance their understanding. This can encourage them to be flexible, and to realize that there can be more than one way of looking at a problem."
8. Participation of students was also increased in all the 3 stories, concrete material and representatives were used more due to which they participated actively in the process as suggested by Bruner and Kenny, 1965 ^[29].
9. A sense of consideration gets developed through the story. "Amanda bean's amazing dream" was carried throughout the week which created a sense of sympathy for the character of the story and considered them as someone significant. E.g.-they started solving her problem as if it was their own. This finding is confirmed by Taplin M. where she mentions that "the

teacher can set a theme for the problems that the pupils make up, such as giving help to others or concern for the environment, which can help them to focus on the underlying values as well as the mathematics”

10. Application of conjectures also increased. This finding is confirmed by O'Connell and Croskey, in the year 2008 where they mention (p60) that “It is a process through which we reorganize our ideas, develop conjectures, and gain insights. It is not content in itself, but a means of exploring and expressing content.”
11. Apart from the advantages of using the stories for the understanding of mathematical concepts, it can be used to break the stereotypes that were there in a child's mind. So, the story is also a medium to break stereotypes.

Discussions

The study answers three research questions as follows:

1. It is important to use stories in a mathematics classroom as with the help of the present study also it can be concluded that stories help children in developing various skills such as reasoning, communication, analogical, visualization, logical-mathematical skill. Moreover, it helps children to think of any other alternative strategy for the given problem which in turn leads to the removal of fixation of methods and encourages children to use conjectures which is difficult while teaching-learning mathematics in a traditional classroom.
2. Different types of stories can be used to teach mathematical concepts. Stories that involve mathematical problems which can help children to use their problem-solving skills and also involve mathematical concepts such as “three little pigs” as suggested by Raudebaugh, MR in his paper “Using children’s literature to teach mathematics”.
3. It is inferred through the present study that by using stories in mathematical classrooms, a variety of changes can be seen. Stories can make children participate actively in mathematical class activities. It ensures the participation of the whole class instead of only those students who are considered good in mathematics. It helps children to not only think about the given problem but also to solve them in different ways. It provides children a wider look at mathematics and increases their participation in classroom discourse. Moreover, usage of a variety of skills and strategies was also seen which is usually difficult to be observed in a traditional mathematical classroom as there is an over-reliance on using a particular method to solve a problem. Also, stories help students to be sensitive and empathetic towards the character of the story. Students looked towards the problem of the character as their own and pondered over different methods to solve them and formed conjectures which are difficult to observe in a traditional classroom in which the problems are abstract in nature and do not connect to the child’s life.

Conclusion

This can be concluded that it is much more beneficial to teach mathematical concepts to students by using stories rather than teaching the concepts by simple traditional computation only as stories help in the development of various skills of mathematics such as problem-solving,

application of logic, analogy, conjectures, and communication. In all the 3 stories as well, students applied the methods or logics that they had experienced earlier. Also, by providing opportunities for children to explore problems given in storybooks using concrete materials and representation, one can help them to apply their own strategies and methods to reach the solution. Not only this, but mathematical stories can help for language development as well as helps in breaking social concepts such as stereotyping.

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